

State Water Resources Control Board

Drinking Water Treatment Exams Expected Range of Knowledge

Exam Content	Number of questions			
	T1	T2	T3	T4
Grade				
Source Water	25	25	20	15
Water Treatment Processes	25	25	35	20
Operation/Maintenance	20	20	15	15
Laboratory Procedures	15	15	15	15
Regulations/Administrative Duties	15	15	15	35

Source Water

Watershed Protection, Wells / Groundwater, Surface Water / Reservoirs, Raw Water Storage, Clear Well Storage

Water Treatment Processes

Coagulation/Flocculation/ Sedimentation, Filtration, Disinfection, Demineralization, Corrosion Control, Iron and Manganese removal, Fluoridation, Water Softening, BAT, (Best Available Technology)

Operation / Maintenance

Chemical feeders, Pumps and Motors, Blowers and Compressors, Water meters, Pressure gauges, Electrical generators, Safety, SCADA systems

Laboratory Procedures

Sampling, General Lab Practices, Disinfectant analysis, Alkalinity analysis, pH analysis, Turbidity analysis, Specific conductance, Hardness, Fluoride analysis, Color analysis, Taste and Odor analysis, Dissolved Oxygen analysis, Algae Count, Bacteriological analysis

Regulations/Administrative Duties

Planning, Organizing, Directing, Controlling, Staffing, Implementing Regulations, Record keeping, Safe Drinking Water Act and amendments, Surface Water Treatment Rule and amendments, Primary Contaminants, Secondary Contaminants, Lead and Copper Rule, Fluoride Regulations, Operator Certification Regulations

EXPECTED RANGE OF KNOWLEDGE WATER TREATMENT EXAMS

(Items marked "T1-T4" may be on the T1 – T4 exams)

(Items marked "T2-T4" may be on the T2 – T4 exams but not on the T1 exam)

Source Water

Wells/Groundwater

T1-T4	Knowledge of the characteristics of aquifers
T1-T4	Knowledge of the chemical components of groundwater
T1-T4	Knowledge of potential contamination in groundwater
T1-T4	Knowledge of well sampling techniques
T1-T4	Knowledge of groundwater characteristics
T1-T4	Ability to analyze water quality characteristics
T1-T4	Ability to calculate well drawdown
T2-T4	Ability to recognize hydrological changes
T2-T4	Ability to calculate a disinfectant dosage in a well
T2-T4	Ability to recognize the influence of surface water on a groundwater source
T2-T4	Ability to calculate well specific capacity
T3-T4	Knowledge of the source water assessment process
T3-T4	Ability to recognize abnormal chemical characteristics of water
T3-T4	Ability to calculate well head pressure

Surface Water/Reservoirs

T1-T4	Knowledge of microbial contamination
T1-T4	Knowledge of flow measurement devices
T1-T4	Ability to recognize potential sources of contamination in surface water
T1-T4	Ability to calculate flow rates
T1-T4	Ability to discriminate between normal and abnormal conditions
T1-T4	Ability to collect a water sample from a surface water source
T1-T4	Ability to calculate the volume of water contained in a storage facility
T1-T4	Ability to recognize abnormal odors or colors
T2-T4	Knowledge of the characteristics of surface waters
T2-T4	Knowledge of the chemical characteristics of surface water
T2-T4	Knowledge of the physical characteristics of surface water
T2-T4	Knowledge of reservoir stratification
T2-T4	Knowledge of the effects of seasonal changes
T2-T4	Knowledge of proper surface water sampling procedures
T3-T4	Ability to interpret water quality reports

Raw Water Storage

T1-T4	Knowledge of water quality characteristics
T1-T4	Knowledge of bacterial contaminants
T1-T4	Knowledge of potential contamination sources
T1-T4	Ability to discriminate between normal and abnormal conditions
T1-T4	Ability to calculate a chemical dosage
T1-T4	Ability to collect a water sample
T2-T4	Knowledge of proper sampling procedures
T2-T4	Ability to measure temperature
T2-T4	Ability to determine water level
T2-T4	Ability to measure turbidity
T2-T4	Ability to calculate detention time

Clear Well Storage

T1-T4	Knowledge of water quality characteristics
T1-T4	Knowledge of bacterial contaminants
T1-T4	Knowledge of proper sampling procedures
T1-T4	Ability to calculate a chemical dosage
T1-T4	Ability to measure temperature
T1-T4	Ability to measure pH
T1-T4	Ability to determine water level
T1-T4	Ability to measure turbidity
T2-T4	Knowledge of potential contamination sources
T2-T4	Ability to discriminate between normal and abnormal conditions
T4	Ability to calculate a CT value

Water Treatment Processes

Coagulation/Flocculation/Sedimentation

T2-T4	Knowledge of safe chemical handling
T2-T4	Knowledge of chemical compatibilities
T2-T4	Knowledge of maximum dose levels
T2-T4	Ability to calculate chemical solution concentration
T2-T4	Ability to analyze a water sample for turbidity
T2-T4	Ability to analyze a water sample for pH
T2-T4	Ability to analyze a water sample for temperature
T2-T4	Ability to measure sludge depth
T3-T4	Knowledge of the coagulation/flocculation process
T3-T4	Knowledge of chemical coagulants and coagulant aids
T3-T4	Knowledge of coagulation/flocculation start-up/shut-down procedures
T3-T4	Knowledge of coagulation/flocculation adjustment procedures
T3-T4	Knowledge of chemical feeder calibration and adjustment
T3-T4	Knowledge of the mixing process
T3-T4	Knowledge of zeta potential
T3-T4	Knowledge of TOC/Disinfection by-product correlation
T3-T4	Knowledge of enhanced coagulation
T3-T4	Ability to recognize normal and abnormal floc formation
T3-T4	Ability to measure turbidity
T3-T4	Ability to analyze a water sample for alkalinity
T3-T4	Knowledge of the sedimentation process
T3-T4	Knowledge of sedimentation basins
T3-T4	Ability to recognize and correct abnormal conditions in the sedimentation basin
T3-T4	Ability to operate a sedimentation basin
T3-T4	Ability to calculate the correct coagulant dosage
T3-T4	Ability to perform a jar test
T4	Ability to determine sludge-depth in solids-contact unit
T4	Ability to operate a solids-contact unit
T4	Ability to operate an up flow clarifier

Filtration

T1-T4	Ability to interpret turbidity information
T1-T4	Knowledge of turbidity causing matter
T2-T4	Knowledge of filtration mechanisms (absorption, adsorption)

T2-T4	Knowledge of head loss effects on filters
T2-T4	Ability to calculate filter-aid dosage
T2-T4	Ability to calculate filtration rate ratio
T2-T4	Ability to calculate filter backwash rate
T3-T4	Knowledge of filter porosity
T3-T4	Knowledge of filter media types and uses
T3-T4	Ability to recognize and correct problems in gravity filters
T3-T4	Knowledge of the diatomaceous earth process
T3-T4	Knowledge of filtration rates
T3-T4	Ability to recognize and correct problems in granular activated carbon filters
T3-T4	Ability to recognize and correct problems in multimedia filters
T3-T4	Ability to calculate filter media volume and capacity
T3-T4	Ability to calculate a filtration rate
T3-T4	Ability to calculate daily filter production
T3-T4	Ability to measure turbidity
T4	Knowledge of filter media replacement considerations, requirements, and techniques

Disinfection

T1-T4	Knowledge of chlorine chemistry
T1-T4	Knowledge of breakpoint chlorination chemistry
T1-T4	Knowledge of proper sampling techniques
T1-T4	Knowledge of safe chemical handling practices
T1-T4	Knowledge of chlorine analysis procedures
T1-T4	Ability to calculate flow rates, volumes, dilution factors, feed rates, and chemical concentrations
T1-T4	Ability to calculate a de-chlorination dosage
T1-T4	Ability to analyze a water sample for free and total chlorine
T1-T4	Knowledge of de-chlorination practices
T2-T4	Knowledge of chloramines chemistry
T2-T4	Knowledge of ammonia feed systems
T2-T4	Ability to calibrate and adjust a chemical feeder pump
T2-T4	Ability to calculate a disinfectant dosage
T2-T4	Ability to calculate an ammonia/chlorine ratio
T3-T4	Knowledge of disinfectant properties and uses (chlorine, chlorine dioxide, chlorine gas, chloramines, ozone)
T3-T4	Knowledge of ozonation system operation
T4	Ability to choose an appropriate disinfectant for a particular bacterial problem
T4	Ability to calculate a CT value

Demineralization

T3-T4	Knowledge of dissolved minerals in water
T3-T4	Ability to analyze a sample for specific conductance
T4	Knowledge of ion exchange processes
T4	Ability to regenerate ion exchange system
T4	Knowledge of specific conductance/TDS ratio
T4	Ability to calculate a TDS value from a specific conductance reading

Corrosion Control

T1-T4	Knowledge of health effects of Pb and Cu
T2-T4	Knowledge of pH adjustment
T2-T4	Knowledge of corrosion causes
T2-T4	Knowledge of C-factor
T2-T4	Ability to recognize corrosion problems
T2-T4	Ability to calculate a chemical feed rate (dose)
T2-T4	Ability to set the proper chemical feed rate
T3-T4	Knowledge of corrosion control inhibitors
T3-T4	Knowledge of corrosion control chemical reactions
T3-T4	Knowledge of the cathodic protection process
T3-T4	Ability to calculate chemical solution concentration
T3-T4	Ability to analyze a water sample for pH
T4	Ability to choose the proper corrosion control chemical for a specific problem

Iron and Manganese

T2-T4	Knowledge of iron and manganese removal processes
T2-T4	Knowledge of proper sampling and preservation techniques
T2-T4	Ability to recognize an iron and manganese problem
T2-T4	Ability to calculate a chemical dosage
T3-T4	Knowledge of iron and manganese oxidation chemistry
T3-T4	Knowledge of oxidation techniques
T3-T4	Ability to calculate chemical solution concentration
T4	Knowledge of ion exchange chemistry

Fluoridation

T1-T4	Knowledge of the health effects of fluoride
T2-T4	Knowledge of back siphoning prevention measures
T2-T4	Knowledge of incompatible chemicals
T2-T4	Ability to calculate a chemical dosage
T3-T4	Knowledge of fluoridation chemicals
T3-T4	Ability to calculate chemical solution concentration
T3-T4	Ability to operate a chemical feeder system
T4	Knowledge of fluoride chemistry

Water Softening

T1-T4	Knowledge of hard water causing chemicals
T2-T4	Knowledge of the water softening processes
T2-T4	Knowledge of acceptable water hardness range
T2-T4	Ability to convert units
T2-T4	Ability to calculate a chemical dosage
T3-T4	Knowledge of hardness removal chemicals
T3-T4	Ability to analyze a sample for water hardness
T3-T4	Ability to calculate blended water concentrations
T4	Ability to calculate the hardness removal capacity of resin

Best Available Technology

T1-T4	Knowledge of waterborne pathogens
T4	Knowledge of BAT (Best Available Technology) for each contaminant
T4	Knowledge of effective removal techniques other than BAT

T4	Knowledge of adverse health effects caused by contaminants
T4	Knowledge of contaminant source or formation chemistry
T4	Knowledge of pharmaceutical contaminants

Operation / Maintenance

Chemical Feeders

T1-T4	Ability to discriminate between normal and abnormal operation
T2-T4	Knowledge of the operation of chemical feeder systems
T2-T4	Knowledge of the components of chemical feeder systems
T2-T4	Knowledge of backpressure retention valves
T2-T4	Ability to calculate a dosage
T2-T4	Ability to replace components of a chemical feeder system
T2-T4	Ability to set speed and stroke

Pumps and Motors

T1-T4	Knowledge of the operation of a water pump
T1-T4	Knowledge of the components of a water pump
T1-T4	Knowledge of pump types
T1-T4	Ability to calculate a flow rate
T3-T4	Ability to discriminate between normal and abnormal operation

Blowers and Compressors

T2-T4	Knowledge of the operation of blowers and compressors
T2-T4	Ability to discriminate between normal and abnormal operation
T4	Knowledge of the components of blowers and compressors

Water Meters

T1-T4	Knowledge of the operation of water meters
T1-T4	Knowledge of water meter types
T1-T4	Ability to discriminate between normal and abnormal operation
T2-T4	Knowledge of the components of water meters

Pressure Gauges

T1-T4	Knowledge of the operation of pressure gauges
T1-T4	Knowledge of head pressure
T1-T4	Ability to discriminate between normal and abnormal operation
T1-T4	Ability to replace pressure gauges

Electrical Generators

T1-T4	Ability to discriminate between normal and abnormal operation
T2-T4	Knowledge of the operation of an electrical generator
T2-T4	Knowledge of basic SCADA system components
T2-T4	Knowledge of SCADA system capabilities
T2-T4	Ability to determine normal operation of a SCADA system
T2-T4	Knowledge of the operation of on-line analyzers
T2-T4	Knowledge of the components of on-line analyzers
T2-T4	Ability to discriminate between normal and abnormal operation of on-line analyzers
T2-T4	Ability to repair or replace EXPENDABLE parts of on-line analyzers
T2-T4	Knowledge of the various types of water flow meters

T2-T4	Knowledge of required reagents for free or total chlorine analysis, and preparation of KI solution
T3-T4	Knowledge of flow rates for low range and high range turbidimeters
T3-T4	Knowledge of cleaning and adjusting the flow of a particle counter
T4	Ability to prepare and calibrate turbidimeters with Primary standard (Formazin)
T4	Ability to adjust STREAMING CURRENT DETECTOR to "zero" using gain knob and knowledge of what this "zero" represents
T4	Ability to prepare and calibrate turbidimeters with Primary standard (Formazin)
T4	Knowledge of what a STREAMING CURRENT DETECTOR readings with regard to coagulation dosage and raw water condition
T4	Ability to standardize a dissolved ozone residual analyzer
T4	Knowledge of the transfer efficiency derived from the relationship between gas phase ozone product gas and off gas analyzers
T4	Ability to calculate U.V. dosages

Laboratory Procedures

Sampling

T1-T4	Knowledge of proper sampling and preservation techniques
T1-T4	Knowledge of appropriate sample containers and required sample sizes
T1-T4	Ability to follow chain-of-custody
T2-T4	Knowledge of maximum holding times
T3-T4	Ability to determine a proper sampling site
T4	Knowledge of giardia and cryptosporidium sampling techniques
T4	Ability to write a sampling plan

General Laboratory Practices

T1-T4	Knowledge of proper chemical handling techniques
T2-T4	Knowledge of quality control procedures
T3-T4	Knowledge of approved analytical procedures
T3-T4	Ability to follow chain-of-custody
T3-T4	Ability to perform dilutions
T3-T4	Ability to calculate a dilution factor

Disinfectant Analysis

T1-T4	Knowledge of abnormal chlorine levels
T1-T4	Knowledge of chlorine analysis techniques (DPD, amperometric)
T3-T4	Knowledge of chlorine chemistry
T3-T4	Knowledge of ozone chemistry
T3-T4	Knowledge of de-chlorination chemistry

Alkalinity Analysis

T1-T4	Knowledge of chemicals that contribute alkalinity to water
T2-T4	Ability to read a pH meter
T3-T4	Knowledge of abnormal alkalinity levels
T3-T4	Ability to use a titrator
T3-T4	Ability to recognize a titration end-point

pH

T1-T4	Knowledge of the pH scale
T1-T4	Knowledge of acids and bases
T1-T4	Ability to read a pH meter
T2-T4	Knowledge of temperature effects on pH
T2-T4	Ability to calibrate a turbidimeter

Specific Conductance

T4	Knowledge of EC/TDS
T4	Ability to read a specific conductance meter

Hardness

T1-T4	Knowledge of chemicals that contribute hardness to water
T2-T4	Knowledge of abnormal hardness levels
T3-T4	Ability to use a titrator
T3-T4	Ability to read a pH meter
T3-T4	Ability to recognize a titration end-point

Fluoride

T2-T4	Knowledge of abnormal levels of fluoride
T3-T4	Knowledge of optimal fluoride level control range

Color Analysis

T3-T4	Knowledge of color analysis scale
T3-T4	Knowledge of abnormal color levels
T3-T4	Knowledge of true and apparent color
T4	Ability to determine small variations in color

Taste and Odor

T2-T4	Knowledge of chemicals that contribute taste and odor
T2-T4	Knowledge of abnormal taste and odors
T3-T4	Knowledge of odor analysis protocol
T3-T4	Ability to identify an objectionable taste or odor

Dissolved Oxygen

T3-T4	Knowledge of normal and abnormal dissolved oxygen levels
T3-T4	Knowledge of the adverse effects of abnormal dissolved oxygen levels
T3-T4	Knowledge of dissolved oxygen measuring devices

Algae Count

T3-T4	Knowledge of algae treatment techniques
T4	Ability to identify algal organisms that impact the water treatment process

Bacteriological Analysis

T2-T4	Knowledge of bacteriological analysis methods
T2-T4	Knowledge of the presence/absence test method
T2-T4	Knowledge of the multiple tube fermentation method
T2-T4	Knowledge of Heterotrophic Plate Count (HPC)
T2-T4	Knowledge of the membrane filtration method
T2-T4	Knowledge of bacteriological testing controls
T2-T4	Ability to distinguish between presumptive and confirmed results

Safety

T1-T4	Knowledge of safe working practices
T1-T4	Knowledge of the use of safety equipment
T1-T4	Knowledge of compressed gas safety procedures
T1-T4	Knowledge of hazardous chemical handling
T1-T4	Knowledge of personal protective equipment (PPE)
T1-T4	Knowledge of lock-out/tag-out procedures
T1-T4	Ability to demonstrate safe work habits
T1-T4	Ability to recognize unsafe working conditions
T2-T4	Knowledge of electrical safety
T2-T4	Ability to select and operate safety equipment
T3-T4	Knowledge of HAZWOPER guidelines
T3-T4	Ability to administer first aid
T3-T4	Ability to administer CPR

Administrative Duties

T1-T4	Knowledge of drinking water regulations
T1-T4	Ability to communicate verbally and in writing
T1-T4	Ability to demonstrate safe work habits
T1-T4	Ability to identify potential safety hazards
T1-T4	Ability to organize information and follow written procedures
T1-T4	Ability to recognize unsafe work conditions
T2-T4	Knowledge of facility operation and maintenance
T2-T4	Knowledge of monitoring and reporting requirements
T2-T4	Ability to determine what information needs to be recorded
T2-T4	Ability to interpret and transcribe data
T3-T4	Knowledge of record keeping requirements
T3-T4	Knowledge of NSF Standards
T3-T4	Ability to evaluate facility performance
T3-T4	Ability to review reports
T3-T4	Ability to translate technical language into common terminology
T4	Ability to calculate the cost of operations
T4	Knowledge of management principles
T4	Knowledge of public relations principles
T4	Knowledge of principles of supervision

Regulations

T1-T4	Knowledge of sampling requirements
T1-T4	Knowledge of turbidity level requirements
T1-T4	Knowledge of disinfection residual requirements
T1-T4	Knowledge of MCLs and MRDLs of disinfectants
T1-T4	Ability to research and interpret MCLs
T2-T4	Knowledge of notification protocol and procedures
T2-T4	Knowledge of public notification procedures
T2-T4	Knowledge of record keeping requirements
T2-T4	Knowledge of corrective actions to take when regulations are violated
T3-T4	Knowledge of reporting procedures
T3-T4	Knowledge of the Consumer Confidence Report (CCR)

T3-T4	Knowledge of regulatory primacy issues
T3-T4	Knowledge of performance standards and removal requirements for the SWTR and IESWTR
T4	Knowledge of the sanitary survey process
T4	Knowledge of the watershed survey process
T4	Knowledge of pending regulations
T4	Knowledge of cryptosporidium action plan
T4	Ability to develop an operations plan
T4	Ability to develop an operational site sampling plan
T4	Ability to conduct a Sanitary Survey
T4	Ability to conduct a Watershed Survey
T4	Ability to perform a filter profile analysis
T4	Ability to perform a filter assessment surveillance program
T4	Ability to conduct a comprehensive performance evaluation

Water Treatment Exam Math

T1-T4	Ability to calculate well drawdown
T1-T4	Ability to calculate flow rates, water velocity
T1-T4	Ability to calculate the volume of water contained in a storage facility
T1-T4	Ability to calculate a chemical, disinfectant dosage
T1-T4	Ability to determine water level
T1-T4	Ability to calculate volumes, dilution factors, feed rates, and chemical concentrations
T1-T4	Ability to calculate a de-chlorination dosage
T1-T4	Ability to calculate chlorine residual
T1-T4	Ability to convert a head pressure to water elevation
T2-T4	Ability to calculate well specific capacity
T2-T4	Ability to calculate detention time
T2-T4	Ability to calculate chemical solution concentration
T2-T4	Ability to calculate filter-aid dosage
T2-T4	Ability to calculate filter backwash rate
T2-T4	Ability to calculate an ammonia/chlorine ratio
T2-T4	Ability to calculate a chemical feed rate (dose) for corrosion control
T2-T4	Ability to calculate a chemical dosage for Fe/Mn removal, fluoridation
T2-T4	Ability to calculate a dosage on a chemical feeder
T3-T4	Ability to calculate well head pressure
T3-T4	Ability to calculate a coagulant dosage
T3-T4	Ability to perform a jar test
T3-T4	Ability to calculate filter media volume and capacity
T3-T4	Ability to calculate a filtration rate
T3-T4	Ability to calculate filter loading rate
T3-T4	Ability to calculate daily filter production
T3-T4	Ability to calculate a chemical solution concentration for Fe/Mn, fluoridation
T3-T4	Ability to calculate blended water chemical concentrations
T3-T4	Ability to calculate % removal of chemical contaminants
T4	Ability to calculate a CT value

T4	Ability to calculate a TDS value from a specific conductance reading
T4	Ability to calculate the hardness removal capacity of resin
T4	Ability to calculate the cost of operations